

Appln. No. 09/975,262
Reply to the Office Action of June 4, 2004

REMARKS

Claims 9-12, 15, 17 and 19-22 have been canceled. Claims 1, 2, 5 and 6 remain active in the case. Reconsideration is respectfully requested.

The present invention relates to a method of producing a sintered silicon nitride filter.

Invention

As claimed in the embodiment of the invention as claimed in Claim 1, a sintered silicon nitride filter is produced by heat-treating, in a nitrogen atmosphere containing no oxygen, a green body comprising from 35 to 90 wt % of silicon nitride particles having an average particle diameter of from 1 to 30 μ m, from 5 to 60 wt % of a pore-forming agent of spherical organic polymer particles selected from the group consisting of a polyvinyl alcohol, an acrylic resin, a vinyl acetate resin or cellulose ranging in size from 20 to 100 μ m and from 0.1 to 5 wt % of metal oxide solid particles, provided that the total amount of the silicon nitride particles, the pore-forming agent and the metal oxide particles is at least 90 wt %, to form a porous product that is effectively useful as a filter for diesel fuel particulates.

Prior Art Rejection

Claims 1, 2, 5, 9-12, 17, 19, 20 and 21 stand rejected based on 35 USC 103(a) as obvious over Niwa et al, '728 in view of Apte et al, '429. This ground of rejection is respectfully traversed.

The Niwa et al patent, as stated previously, discloses a porous ceramic product that possesses thermal shock resistance. The product is prepared by heating a raw material ceramic

powder that is selected from a group of materials including silicon nitride. In the thermal process of forming the porous ceramic product, hollow oxide particulate material is used as the means of introducing porosity into the ceramic product obtained. The sintered product obtained is used as a valve unit that has high durability.

The presently claimed method, however, is clearly distinguished over the method of forming a porous ceramic article of the reference in that in heat-treating a green body of material, the green body is constituted, in part, of a specific amount of spherical polymer particle material from the four types of organic materials specified in the Claim 1 and from 0.1 to 5 wt % of solid metal oxide particles. The porosity and average pore diameter characteristics of the porous silicon nitride product produced result from the use of these two materials. Note as described on page 9 of the text that if the solid metal oxide particles are used in an amount of less than 0.1 wt %, the density of the structure of the backbone of the silicon nitride matrix is not sufficient and therefore a product of sufficiently high strength cannot be obtained. On the other hand, if the content of the solid metal oxide particles is greater than 5 wt %, the heat resistance of the silicon nitride product is impaired. Accordingly, the failure of the reference to teach or suggest the combination of the organic particles and the solid metal oxide particles is important , which is made even more significant in view of the fact that the patent in the Experiment of columns 8 and 9 and in Table 1 teaches that hollow metal oxide particles produce a product that is superior for the purposes of the patent in producing a valve unit than various resin particles of a size of about 100 μm in producing a porous ceramic product. Table 1 clearly demonstrates that the sliding durability and the thermal shock resistance of two examples of porous Al_2O_3 which were formed from a composition that contained hollow

particles of $\text{SiO}_2/\text{Al}_2\text{O}_3$ were superior to three sintered Al_2O_3 products (Comp. Exs. 1, 2 and 3) prepared from ceramic mixtures containing epoxy resin particles, acrylic resin particles and phenolic resin particles, respectively. Clearly, to the extent of preparing sintered ceramic material having the stated pore size and porosity characteristics of the invention disclosed in Niwa et al, one of skill in the art would not be led to employ organic materials as pore forming substances in the production of porous ceramic materials of the type disclosed in the reference. Certainly, the skilled artisan would not be led to the combined use of organic particles and a limited amount of solid metal oxide particles to prepare a sintered ceramic product.

Given the very significant differences in the composition of the green body material of the present invention and the material which is sintered to prepare the ceramic product of the reference, it is clear that the presently claimed porosity characteristic of 30 to 80 % and an average pore diameter ranging from 5 to 40 μm are descriptive a sintered ceramic product that is materially different from the product of the reference that has a porosity of 2 to 40 %, preferably from 3 to 10 % and an average pore diameter ranging from 5 to 300 μm , preferably 20 to 250 μm , despite the fact that some overlap exists between the porosity and pore size ranges of the product of the present invention and that of Niwa et al.

As to the Apte et al patent, applicants maintain their position of record that given the inferiority of several porous sintered alumina products prepared by using organic resins as pore forming materials to porous sintered alumina products prepared by using particulate hollow oxide materials as pore forming material as taught by Niwa et al, one of skill in the art would not be led by Apte et al to use the organic materials disclosed therein as a substitute for the particulate hollow oxide material taught by Niwa et al for the manufacture of porous ceramic

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products. Moreover, none of the graphite, carbon, starch and polyethylene materials specifically disclosed in Apte et al are the specifically identified polymer particles of the present claims. Thus, the Apte et al does not overcome or improve upon the deficiencies of Niwa et al and withdrawal of the obviousness ground of rejection is respectfully requested.

Claims 6 and 15 stand rejected based on 35 USC 103(a) as obvious over Niwa et al, '728 in view of Apte et al, '429 and further in view of Watanabe et al. This ground of rejection is respectfully traversed.

The rejection of Claim 15 is obviated by its cancellation.

As to Claim 6, while it is essential to conduct the heat-treating step of the present process under an atmosphere of substantially nitrogen, the specific temperature and time conditions of the claim are not features upon which the patentability of the invention depends. Accordingly, withdrawal of the rejection is respectfully requested.

Claim 22 stands rejected based on 35 USC 103(a) as obvious over Niwa et al, '728 in view of Apte et al, '429 and further in view of Wise et al. This ground of rejection is respectfully traversed.

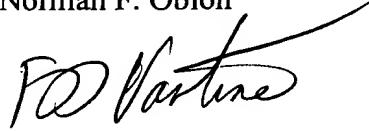
The rejection of Claim 22 is obviated by its cancellation.

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It is believed that the application is in condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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